

See Job 758

for Cert L-LSH08-157/D

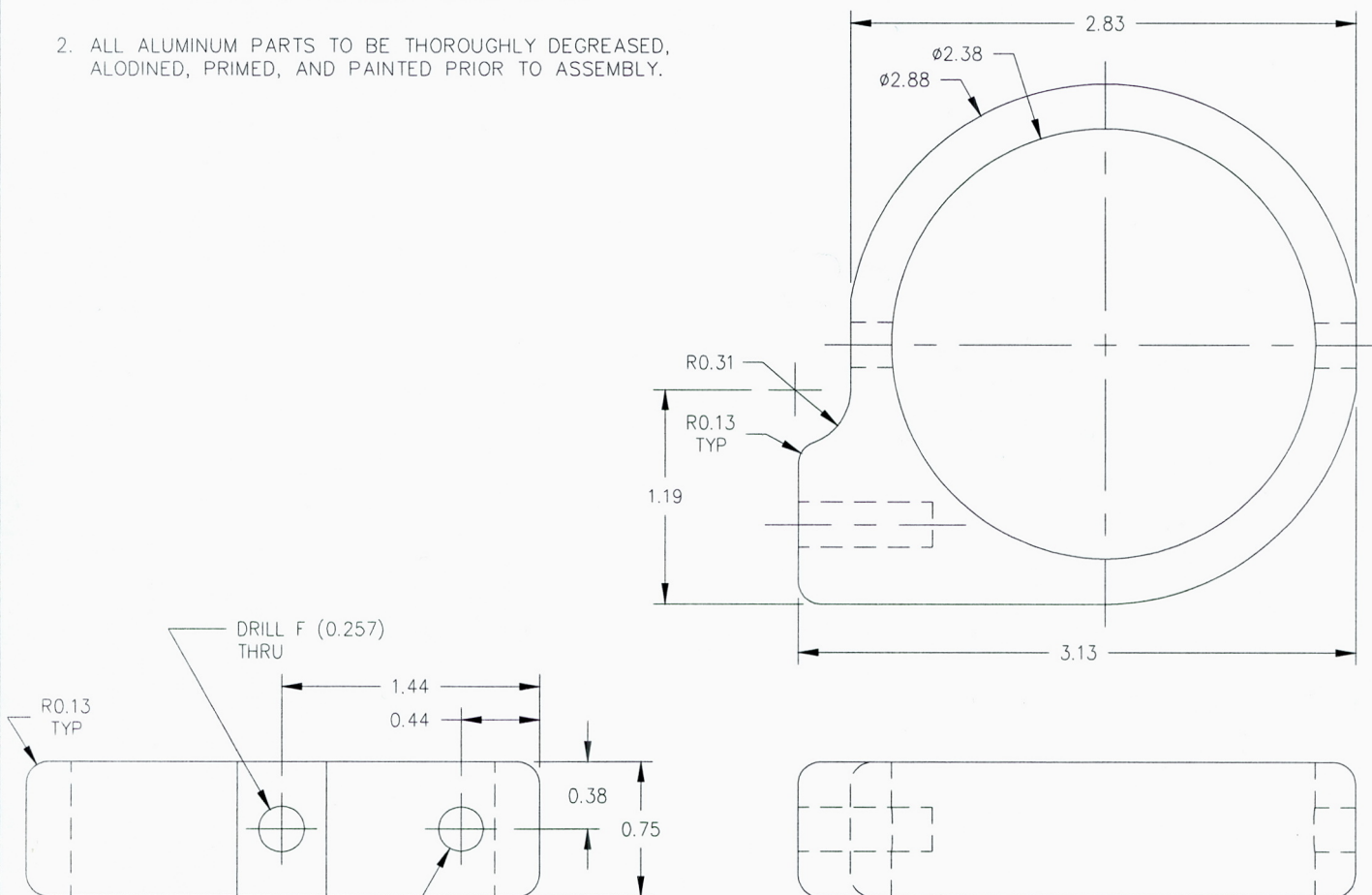
AE100 (AE758-5)
Series

DCLs

| REV. | DESCRIPTION OF CHANGE | INITIALS | DATE |
|------|-----------------------|----------|------|
| 0 | INITIAL ISSUE | | |

NOTES

1. REMOVE ALL BURRS AND BREAK SHARP EDGES.
2. ALL ALUMINUM PARTS TO BE THOROUGHLY DEGREASED, ALODINED, PRIMED, AND PAINTED PRIOR TO ASSEMBLY.



01 BRACKET

| 1 | 3591-4CN375 | 02 | 1/4-28 HELICOIL | | | |
|-----|-------------|------|-----------------|------------------|---------------|---------------|
| 1 | 80120-01 | 01 | BRACKET | 6061-T6 ALUMINUM | QQ-A-200/8 | 3.0 X 1.0 BAR |
| QTY | PART NO. | ITEM | DESCRIPTION | MATERIAL | MATERIAL SPEC | STOCK SIZE |

LIST OF MATERIALS

| | | | | | | | | | |
|---|--|--------------|-------------|----|---|-------|-----------|---|----------|
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| | DRAWN: JEFF CLARKE | | 23 MAY 2008 | | | | | | |
| | CHECKED: E. BURGAIN | | | | | | | | |
| | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON: DECIMALS ANGLES X.XXX ±0.010 ±1/2° X.XX ±0.03 X.X ±0.1 | | | | BELL 205A-1, 212, 412 SERIES ALPINE SHOULDER BELT MODIFICATION BRACKET FABRICATION | | | | |
| | | | | | SCALE 1 : 1 | | DWG. SIZE | | DWG. NO. |
| | | SHEET 1 OF 1 | | A4 | | 80120 | | 0 | |

AERO Design Ltd.

ENGINEERING REPORT ER801.01

Shoulder Harness Bracket

Bell 412, 212, 205A-1, 205B

Approved by: E. Burgoin, P. Eng.

Prepared by: Richard Rathwell

Revision 0
Date: 14 May, 2008

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Engineering Consultants

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1.0 INTRODUCTION

This document will show elements the installation of the Shoulder Harness Bracket p/n 80120 is in compliance with Federal Aviation Regulations

This installation replaces the stanchion post collar assembly of the Alpine Aerotech Ltd. Shoulder Harness Kit on the seat post stanchion with a bracket that will interface with the Aero Design Ltd. Cargo Deployment Arm.

2.0 REFERENCE

AERO Design Ltd. Drawing 79220 Cargo Arm Assembly

AERO Design Ltd. Drawing 80120 Bracket Assembly

AERO Design Ltd. Document ER758.01

FAR 29.561 Emergency Landing Conditions

FAR 29.785(f) Seats, Safety Belts, and Harnesses

AC 29-2B Certification of Transport Category Rotorcraft

3.0 BASIS OF CERTIFICATION

Bell 412: FAR Part 29 dated 1 February 1965, Amendment 29-1 and 29-2

Bell 212: FAR Part 29 dated 1 February 1965, Amendment 29-1 and 29-2

Bell 205A-1: CAR 7 dated August 1, 1956, Amendments 7-1 through 7-4

Bell 205B: CAR 7 dated August 1, 1956, Amendments 7-1 through 7-4

This installation: FAR Part 29 dated 1 February 1965, Amendment 29-1 and 29-2 and Amendment 29-43 for 29.865(a) and 29.865(e)

4.0 ANALYSIS OF CURRENT AIRWORTHINESS DIRECTIVES (AD'S)

There are no current AD's related to this installation. Refer to Aero Design Ltd. Document ER758.01 for details.

5.0 STRUCTURAL ANALYSIS – SHOULDER HARNESS BRACKET

5.1 Loads and Factors

Factors

Inertia Forces (Ultimate) per 29.561

Upward $n_{ult_up} := 1.5$

Forward $n_{ult_fwd} := 4.0$

Sideward $n_{ult_side} := 2.0$

Downward $n_{ult_down} := 4.0$

Shoulder Harness Attachment
Multiplication Factor Per 29.785

$n_{mf} := 1.33$

Loads

AC 29-2B para 335A b. (3) states;

(3) Shoulder harnesses need only be substantiated for 40 percent of total occupant load rather than the former 60 percent adopted by Amendment 29-24.

This analysis will conservatively substantiate for 60% of the occupant's load, therefore the applicable loads for analysis are;

Weight of Occupant per 29.785

$wt_{occ} := 170 \cdot \text{lbf}$

Upward $P_{ult_up} := n_{ult_up} \cdot n_{mf} \cdot wt_{occ} \cdot .6$ $P_{ult_up} = 203.49 \text{ lbf}$

Forward $P_{ult_fwd} := n_{ult_fwd} \cdot n_{mf} \cdot wt_{occ} \cdot .6$ $P_{ult_fwd} = 542.64 \text{ lbf}$

Sideward $P_{ult_side} := n_{ult_side} \cdot n_{mf} \cdot wt_{occ} \cdot .6$ $P_{ult_side} = 271.32 \text{ lbf}$

Downward $P_{ult_down} := n_{ult_down} \cdot n_{mf} \cdot wt_{occ} \cdot .6$ $P_{ult_down} = 542.64 \text{ lbf}$

5.2 Analysis

AN4 Bolt Attaching Harness to Bracket

Properties - AN4 Bolt

Tension

$$F_{tu_AN4} := 4170 \cdot \text{lbf}$$

Single Shear

$$F_{su_AN4} := 3680 \cdot \text{lbf}$$

Reaction - Downward Load

$$MS_{\text{down_AN4_harness}} := \frac{F_{su_AN4}}{P_{ult_down}} - 1$$

$$MS_{\text{down_AN4_harness}} = 5.782$$

MARGIN OF SAFETY IS POSITIVE

Reaction - Forward Load

This load and the bolt strength allowable is identical to the downward load case, therefore:

MARGIN OF SAFETY IS POSITIVE

Reaction - Upward Load

This load is less than the downward and forward load cases, while the bolt strength allowable remains the same, therefore:

MARGIN OF SAFETY IS POSITIVE

Reaction - Sideward Load

$$MS_{\text{side_AN4_harness}} := \frac{F_{tu_AN4}}{P_{ult_side}} - 1$$

$$MS_{\text{side_AN4_harness}} = 14.369$$

MARGIN OF SAFETY IS POSITIVE

Analysis - Bracket Threads in Shear - Engaged with Helicoil

Assumption: Thread Engagement is 1.0 x Bolt Dia., 1/4 inch dia (assumed smaller than actual and therefore this analysis shall conservatively work with less shear area).

Mechanical Properties of Thread Engagement:

$$D_{AN4} := 0.25 \cdot \text{in}$$

$$L_{\text{engage}} := D_{AN4} \cdot 1.0$$

$$L_{\text{engage}} = 0.25 \text{ in}$$

Pitch Diameter:

$$D_{p_25} := 0.227 \cdot \text{in}$$

$$A_{s_25} := \pi \cdot D_{p_25} \cdot L_{\text{engage}} \cdot 0.5$$

$$A_{s_25} = 0.089 \text{ in}^2$$

$$\tau_{\text{thread_25}} := \frac{P_{\text{ult_side}}}{A_{s_25}}$$

$$\tau_{\text{thread_25}} = 3043.7 \text{ psi}$$

Mechanical Properties of 6061-T651
Per MMPDS-01

Shear

$$F_{su_6061} := 27 \cdot \text{ksi}$$

Margin of Safety:

$$MS_{\text{thread_25}} := \left(\frac{F_{su_6061}}{\tau_{\text{thread_25}}} \right) - 1$$

$$MS_{\text{thread_25}} = 7.9$$

MARGIN OF SAFETY IS POSITIVE

Analysis of the Stanchion Bolt (AN4)

Forward Load (See FIGURE 5.2.1)

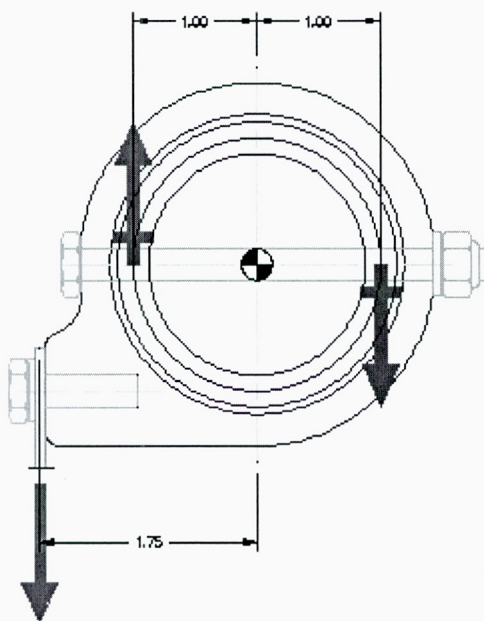


FIGURE 5.2.1

Eccentric Load Analysis of Stanchion Bolt

Distance of the load from the centroid (center of stanchion) $D_{cent_load} := 1.75\text{-in}$

Distance of the bolt shear plane to the centroid (2 places - equal) $D_{cent_shear} := 1.00\text{-in}$

Stress

$$\tau_{fwd_AN4_stan} := \frac{P_{ult_fwd} \cdot D_{cent_load}}{2 \cdot D_{cent_shear}} \quad \tau_{fwd_AN4_stan} = 474.81 \text{ lbf}$$

Margin of Safety

$$MS_{fwd_AN4_stan} := \frac{F_{su_AN4}}{\tau_{fwd_AN4_stan}} - 1 \quad MS_{fwd_AN4_stan} = 6.75$$

MARGIN OF SAFETY IS POSITIVE

Sideward Load

This load case is somewhat similar to the forward load case in the manner for which the load is reacted, however the sideward load acts closer to the centroid of the bracket installation. Therefore the critical load case is the forward load case, detailed above.

Downward and Upward Load

These load cases place the AN4 Bolt in double shear - The downward load case is critical. The AN4 Bracket bolt has been analyzed in single shear above (see AN4 Bolt attaching Harness to Bracket Analysis) and the margin of safety was positive.

Analysis of the Bracket

Forward Load (See FIGURE 5.2.2)

Eccentric Load Analysis of Bracket - Reaction at "B" and "D" - Reactions are equal, but opposite.

$$\tau_{fwd_ecc} := \frac{P_{ult_fwd} \cdot 1.75\text{-in}}{2 \cdot 1.19\text{-in}} \quad \tau_{fwd_ecc} = 399 \text{ lbf}$$

Reactions at "B" and "D" due to forward load.

$$\tau_{fwd_fwd} := \frac{P_{ult_fwd}}{2} \quad \tau_{fwd_fwd} = 271.32 \text{ lbf}$$

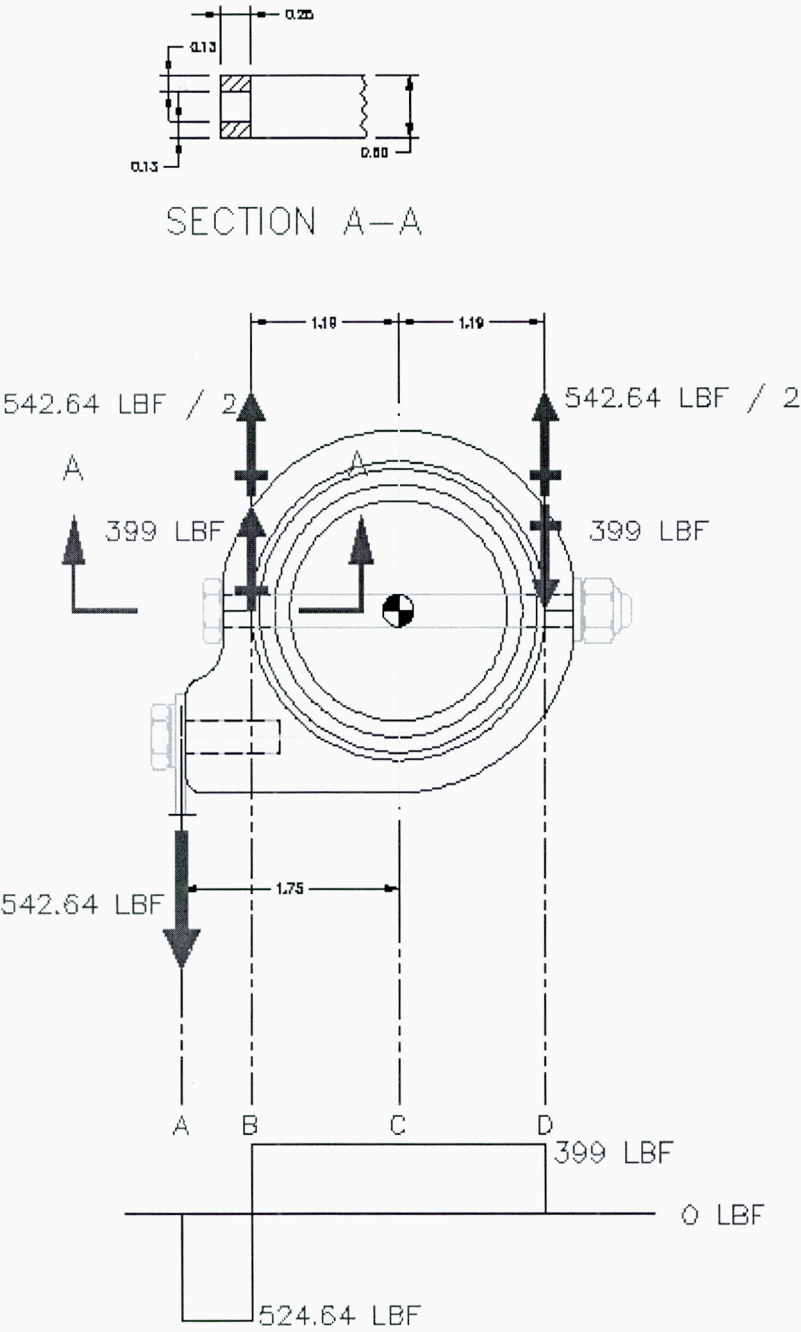


FIGURE 5.2.2

Resolved Reactions at "B" and "D"

$$R_B := \tau_{fwd_ecc} + \tau_{fwd_fwd}$$

CRITICAL

$$R_B = 670.32 \text{ lbf}$$

$$R_D := -\tau_{fwd_ecc} + \tau_{fwd_fwd}$$

$$R_D = -127.68 \text{ lbf}$$

Section Area and "B"

$$A_B := 0.125 \cdot \text{in}^2$$

Mechanical Properties 6061-T651

Tension

$$F_{tu_6061} := 42 \cdot \text{ksi}$$

Stress

$$\sigma_B := \frac{R_B}{A_B}$$

$$\sigma_B = 5362.6 \text{ psi}$$

Margin of Safety

$$MS_{fwd_bracket_B} := \frac{F_{tu_6061}}{\sigma_B} - 1$$

$$MS_{fwd_bracket_B} = 6.8$$

MARGIN OF SAFETY IS POSITIVE

Sideward Load

This load case is somewhat similar to the forward load case in the manner for which the load is reacted, however the sideward load acts closer to the centroid of the bracket installation. Therefore the critical load case is the forward load case, detailed above.



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, DC

TSO-C39b

Date: 4/17/87

Technical Standard Order

Subject: TSO-C39b, AIRCRAFT SEATS AND BERTHS

a. Applicability.

(1) Minimum Performance Standards. This technical standard order (TSO) prescribes the minimum performance standards that aircraft seats and berths of the following types must meet in order to be identified with the applicable TSO marking:

- Type I - Transport (9g forward load)
- Type II - Normal and Utility
- Type III - Acrobatic
- Type IV - Rotorcraft

Seats and berths that are to be so identified and that are manufactured on or after the date of this TSO must meet the minimum performance standards set forth in National Aircraft Standard (NAS) Specification 809, dated January 1, 1956, with the exceptions covered in subparagraph a.(2) of this TSO. Seats and berths approved prior to the date of this TSO may continue to be manufactured under the provision of their original approval.

(2) Exceptions.

(i) The sideward loads as specified in 4.1.2. Table I of NAS 809 need not exceed the requirements of the applicable Federal Aviation Regulations (FAR).

(ii) In lieu of compliance with 2.1, 3.1.2, and 4.3.2 of NAS 809, materials in Type I seats must comply with the fire protection provisions of FAR Section (§) 25.853, including the requirements of § 25.853(c), effective 11/26/84. Materials in Type I berths must comply with the fire protection provisions of § 25.853(b).

DISTRIBUTION: ZVS-326; A-W(WS)-3; A-X(FS)-3; A-FFS-1,2,7,8,(LTD); A-FAC-0(MAX);
A-X(CD)-4; AVN-1(2 cys)

(3) Additions. Test for Fire Blocking of Seat Cushions: Tests must be conducted in accordance with Appendix F, Part II of FAR Part 25.

b. Marking. In addition to the marking specified in FAR § 21.607(d), the following additional information must be shown when tested to the fire blocking requirements of paragraph a.(3) of this TSO.

“Complies with FAR § 25.853(c), effective 11/26/84.”

c. Data Requirements. In addition to FAR § 21.605, the manufacturer must furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration, having purview of the manufacturer’s facilities, one copy of the following technical data:

(1) A drawing list, enumerating all of the drawings and processes that are necessary to define the articles design.

(2) The manufacturer’s equipment operating instructions and limitations.

(3) The applicable installation instructions indicating restrictions or other conditions pertinent to installation.

(4) The manufacturer’s test report of tests results required in 4.3 of NAS 809.

(5) The manufacturer’s special cleaning and maintenance instructions.

(6) When testing is conducted to the fire blocking requirements of paragraph a.(3) of this TSO, a report containing the test results must be submitted.

(7) In addition, a note with the following statement must be included:

“The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install the article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. If not within the TSO standards, the article may be installed only if further evaluation by the applicant documents an acceptable installation and is approved by the Administrator.”

d. Availability or Referenced Documents.

(1) Copies of NAS Specification No. 809 may be purchased from the National Standards Association, 5161 River Road, Bethesda, Maryland 20816.

(2) Federal Aviation Regulations, Part 21, Subpart O, and Advisory Circular 20-110C, “Index of Aviation Technical Standard Orders,” may be reviewed at FAA

4/17/87

TSO-C39b

Headquarters in the Office of Airworthiness, Aircraft Engineering Division, (AWS-120), and at all regional ACO's.

/S/ M. C. Beard
Director of Airworthiness



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C39c

Effective
Date: 2/13/04

Technical Standard Order

Subject: 9g TRANSPORT AIRPLANE SEATS CERTIFIED BY STATIC TESTING

1. PURPOSE. This Technical Standard Order (TSO) tells persons seeking a TSO authorization or letter of design approval what minimum performance standards (MPS) that their aircraft seats must first meet in order to obtain approval and be identified with the applicable TSO-C39c marking:

Type A - Transport Airplane

“Type I” was changed to “Type A” when TSO-C39c was issued. Type A seats must meet the requirements in section 3 of this document.

Persons seeking a TSO authorization or letter of design approval for seats used in the following types of aircraft can still apply for TSO-C39b:

Type II - Normal, Utility, and Commuter

Type III - Acrobatic

Type IV - Rotorcraft

TSO authorizations or letters of design approval for seats formerly designated as Type I for use in transport airplanes will no longer be issued. All new TSO authorizations or letters of design approval for seats used in transport airplanes must be issued as TSO-C39c, Type A seats. All TSO-C39b authorizations or letters of design approval issued prior to TSO-C39c remain valid including those issued for Type I seats.

2. APPLICABILITY.

a. This TSO is effective for new applications for Type A seats submitted after the effective date of this TSO. TSO-C39b is still effective for Type II, III, and IV seats as described above and for aircraft berths. Applications for Type I seats will not be accepted after the effective date of this TSO. However, applications submitted against the previous version of this TSO for Type I seats may be accepted up to six months after the effective date of this TSO, in cases where we know that the applicant was working against the earlier MPS before the new change became effective.

b. Seats and berths approved under a previous TSO authorization may continue to be manufactured under the provisions of their original approval, as specified in 14 CFR § 21.603(b). However, major design changes to seating systems approved under previous versions of this TSO require a new authorization under this TSO, per Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).

3. REQUIREMENTS. New models of seating systems that are to be so identified and are manufactured on or after the effective date of this TSO must meet the MPS, qualification requirements, and minimum documentation requirements set forth in Sections 3.2, 3.3, 3.4 (except 3.4.2), 3.5, 4 (except 4.2), 5 (except 5.3 and 5.4) of the Society of Automotive Engineers, Inc. (SAE), Aerospace Standard (AS), 8049 Rev. A, "Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft" dated September 1997 when revised by paragraph 3.a of this document.

a. In order to meet this TSO, SAE AS8049 Rev. A must be revised to as follows:

(1) Disregard first paragraph in section 3.2 Requirements.

(2) Revise Section 3.2.1 of AS 8049 Rev. A as follows:

Seat systems shall be designed to provide protection for the occupant at seat adjustment positions, orientations, and locations allowed to be occupied during takeoff and landing.

(3) Revise Section 3.2.2 of AS 8049 Rev. A as follows:

Seat elements shall be designed so that, when evaluated under the static test conditions of this document, they do not leave hazardous projections that could significantly contribute to occupant injury or impede rapid evacuation.

(4) Revise Section 3.2.6 of AS 8049 Rev. A as follows:

Adjustable features (seat swivel, back recline, and stowage of movable tables, armrests, footrests, etc.) shall be designed to permit the seat occupant access to those features to adjust to the positions required for takeoff and landing without releasing the occupant's restraints.

(5) Revise Section 3.2.7 of AS 8049 Rev. A as follows:

When an under-seat baggage restraint is incorporated in a passenger seat, it shall be designed to restrain at least 9.1 kg (20 lb) or its placarded weight of stowed items per passenger place under the static test conditions of this document in a manner that will not significantly impede rapid egress from the seat.

(6) Revise Section 3.5 of AS 8049 Rev. A as follows:

Allowable permanent deformations sustained by a seat subjected to the ultimate static tests of this document are specified below. Permanent seat deformations shall be measured on the critically loaded seat after static tests. Significant measuring points shall be identified and marked on the test seat, and their positions measured in the lateral, vertical, and longitudinal directions relative to fixed points on the test fixture. Measurement of the selected points shall be recorded before and after the tests. Posttest deformations shall be recorded and reported.

(7) Revise Section 4 of AS 8049 Rev. A as follows:

STRENGTH:

All seats qualified for occupancy during takeoff and landing shall be capable of withstanding, within the criteria defined below, statically applied loading.

(8) Revise Section 5 of AS 8049 Rev. A as follows:

QUALIFICATION TESTS:

Initial qualification of a seat shall be performed by static tests. Subsequent qualifications related to design changes to seats of a similar type may be performed by rational analysis based on existing qualification test data.

b. In addition to the requirements above, paragraphs 3.1.4, 3.1.8, 3.1.11 (as revised below), 3.1.14, 3.1.15, 3.1.17, 3.1.18, 3.1.19, and 3.1.20 of SAE AS 8049 Rev. A are requirements of this TSO and must be met before identifying any article per the marking requirements of Section 4 of this TSO.

(1) Revise Section 3.1.11 of AS 8049 Rev. A as follows:

Restraint system anchorages should provide self-aligning features. If self-aligning features are not provided, the static tests in this document should be conducted with the restraints and anchorages positioned in the most adverse configuration allowed by the design. The anchorage system should minimize the possibility of incorrect installation or inadvertent disconnection of the restraints.

c. Seat cushions, when included, for transport airplane passenger, flight attendant, and observer seats must be tested and must meet the fire protection provisions of Appendix F, Part II of 14 CFR Part 25, as required in 14 CFR 25.853(c) effective March 6, 1995 or the equivalent must be demonstrated by analysis (similarity) to provide equivalent protection.

d. **Deviations.** The FAA has provisions for using alternative or equivalent means of compliance to the criteria set forth in the MPS of this TSO. Applicants invoking these provisions shall demonstrate that an equivalent level of safety is maintained and shall apply for a deviation per 14 CFR § 21.609.

4. MARKING. Under 14 CFR § 21.607(d), articles manufactured under this TSO must be marked as follows:

a. At least one major component must be permanently and legibly marked with all of the information listed in 14 CFR § 21.607(d), except for the following: the option in 14 CFR § 21.607(d)(2), where the name, type and part number must be used in lieu of the optional model number; and the option in 14 CFR § 21.607(d)(3), where the date of manufacture must be used in lieu of the optional serial number. The marking must also include the appropriate seat facing direction designation: "FF"-forward; "RF"-rearward; or "SF"-sideward.

b. In addition to the requirements of 14 CFR 21.607(d), each passenger, flight attendant, and observer seat cushion required for qualification of the seating system must be marked with "Complies with 14 CFR 25.853(c) effective March 6, 1995" when tested in accordance with the requirements of Section 3.c. of this TSO.

5. DATA REQUIREMENTS.

a. Application Data. Under 14 CFR § 21.605(a)(2), the manufacturer must furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration (FAA), responsible for the manufacturer's facilities, one copy each of the following technical data to support the FAA design and production approval:

(1) Operating instructions and equipment limitations. The limitations shall be sufficient to describe the operational capability of the equipment. In particular, operational or installation limitations resulting from specific deviations granted must be described in detail.

(2) Installation procedures and limitations. The limitations shall be sufficient to ensure that the seating system, when installed according to the installation procedures, continues to meet the requirements of this TSO. The limitations shall identify any unique aspects of the installation. Finally, the limitations also shall include a note with the following statement:

The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

(3) Schematic drawings, as applicable to the installation procedures.

(4) Wiring diagrams, as applicable to the installation procedures.

(5) List of the components, by part number, that make up the seating system complying with the standards prescribed in this TSO. Manufacturers should include vendor part number cross-references when applicable.

(6) Instructions, in the form of a Component Maintenance Manual (CMM) containing information on the periodic maintenance, calibration and repair, for the continued airworthiness of installed seating systems, including recommended inspection intervals and service life. Details of deviations granted, as noted in paragraph 5.a.(1) of this TSO, may also be described in the CMM.

(7) Material and process specifications list.

(8) The quality control system description required by 14 CFR §§ 21.605(a)(3) and 21.143(a) including functional test specifications to be used to test each production article to ensure compliance with this TSO.

(9) Manufacturer's TSO qualification test report.

(10) Nameplate drawing providing the information required by paragraph 4 of this TSO.

(11) A list of all drawings and processes, including revision level, necessary to define the article's design. In the case of a minor change, any revisions to the drawing list need only be made available upon request.

(12) Flammability test results on representative seat cushions with dress covers conducted per Section 3.c of this TSO.

(13) Static qualification test results on the seating system as per Section 5.1 of SAE AS 8049 Rev. A.

b. Manufacturer Data. In addition to the data to be furnished directly to the FAA, each manufacturer must have available for review by the manager of the ACO responsible for the manufacturer's facilities the following technical data:

(1) The functional qualification specifications to be used to qualify each production article to ensure compliance with this TSO.

(2) Equipment calibration procedures.

(3) Corrective maintenance procedures within 12 months after TSO authorization.

(4) Schematic drawings.

(5) Wiring diagrams.

(6) Material and process specifications.

c. Furnished Data. One copy of the Application Data specified in paragraphs 5.a.(1) through 5.a.(6) of this TSO and any other data or information necessary for the proper installation, certification and use and/or for continued airworthiness of the seating system, must accompany each article or multiple articles, if furnished to one source, i.e. operator, type certificate holder, etc., manufactured under this TSO.

6. AVAILABILITY OF REFERENCED DOCUMENTS.

a. You may buy copies of SAE AS8049 Rev. A from the Society of Automotive Engineers Inc., Department 331, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Copies also can be obtained through the SAE Internet website @ www.sae.org.

b. You may buy copies of Federal Aviation Regulations 14 CFR part 21, Subpart O, 14 CFR Part 23, 14 CFR Part 25, 14 CFR Part 29, and 49 CFR Part 572 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402-9325. Copies also can be obtained from the Government Printing Office (GPO), electronic CFR Internet website @ <http://www.gpoaccess.gov/ecfr>.

c. Advisory Circular (AC) 20-110, "Index of Aviation Technical Standard Orders," and AC 20-36, "Index of Articles Certified under the Technical Standard Order System" may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785, telephone (301) 322-4477 or FAX (301) 386-5394. Copies also may be obtained from the FAA Internet website at <http://www2.faa.gov/regulations/Guidance.cfm> and select the "Advisory Circulars" option.

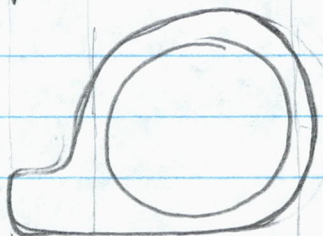
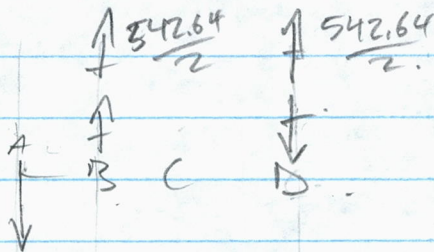
/S/ David Hempe
Manager, Aircraft Engineering Division
Aircraft Certification Service

FE30 (011)

Down 2150 lb.

$$\sum M_G = 0$$

$$= 542.64 \times 2.94 - 1 \cdot B$$



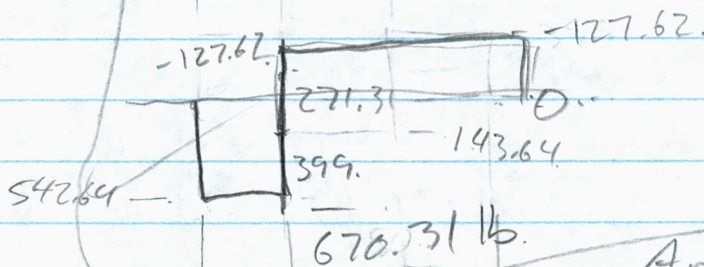
$$\sum M_G = 0$$

$$= 54264 \text{ lb} \times 1.75 \text{ in.}$$

$$-(R_B \times 1.19 \text{ in} + R_D \times 1.19 \text{ in})$$

$$R_B = \frac{949.62 \text{ in} \cdot \text{lb}}{2.38}$$

$$R_B = 399 \text{ lb}$$

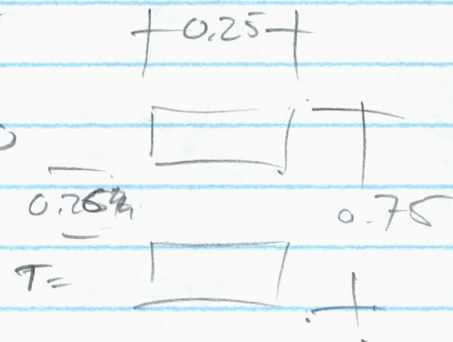
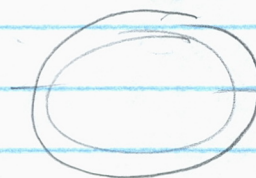
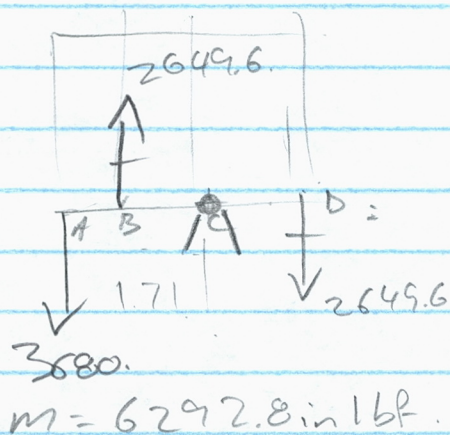
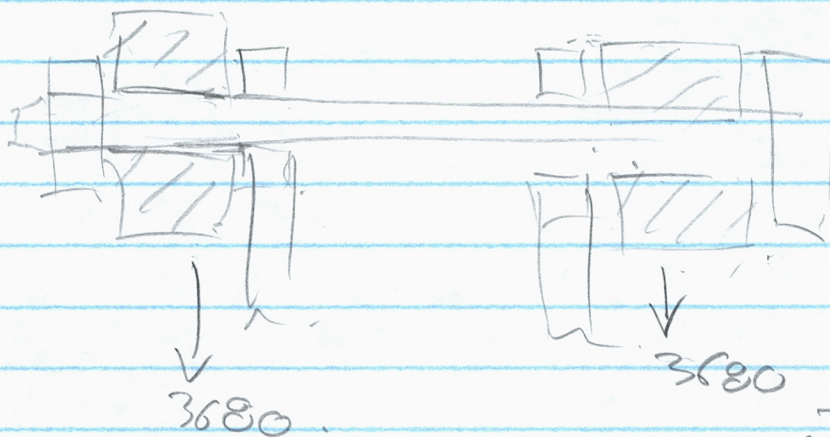
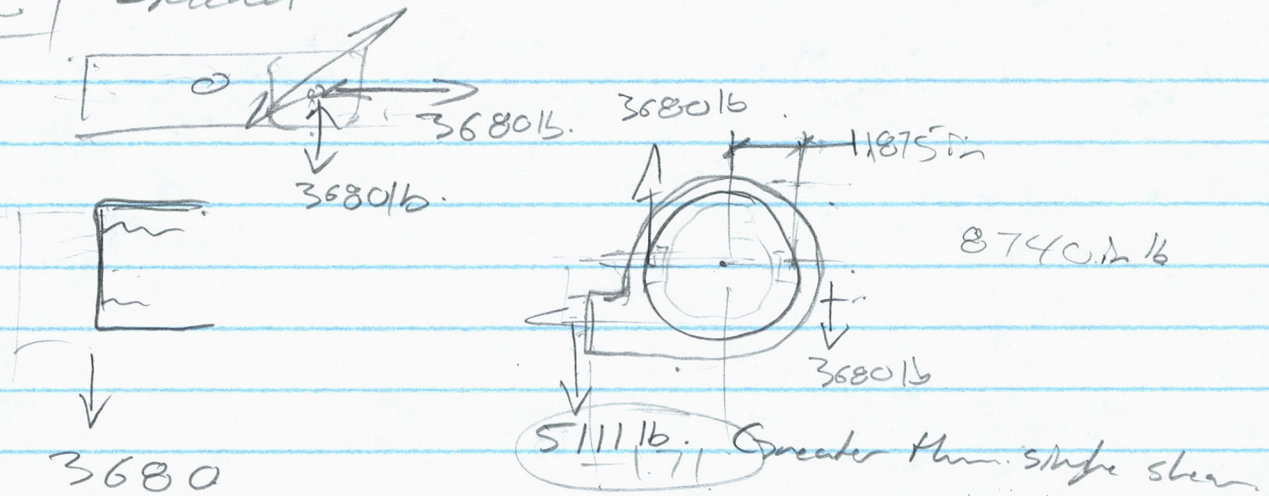


$$Area = 0.5 \times 0.25 = 0.125 \text{ in}^2$$

Stress

$$\sigma = \frac{F}{A} = \frac{670.31 \text{ lb}}{0.125 \text{ in}^2} = 5,362.48 \text{ psi}$$

Allowable / Bracket



$A = 0.49 \times 0.25$
 $= 0.1225 \text{ in}^2$
 6061-T6 $F_{tu} = 42 \text{ ksi}$
~~good for~~
 $F_{tu} \times A = 5,145 \text{ ksi}$

$\sum M_C = 0$
 $= 3680 \text{ lb} \times 1.175 \text{ in} - R_B \times 1.175 \text{ in} - R_D \times 1.175 \text{ in}$

$R_B = R_D$
 $R_B + R_D = 2R_B$

$2R_B = 6292.8 \text{ in} \cdot \text{lb} - 2R_B \times 1.175 \text{ in}$

$2R_B = \frac{6292.8 \text{ in} \cdot \text{lb}}{1.175 \text{ in}} = 5299.2 = 2649.6 \text{ lb}$

- This is less than
 also less than Bolt shear



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, DC

TSO-C39a
Date: 2/24/72

Technical Standard Order

Subject: TSO-C39a, AIRCRAFT SEATS AND BERTHS

(a) Applicability - (1) Minimum performance standards. (1) This technical standard order prescribes the minimum performance standards that aircraft seats and berths of the following types must meet in order to be identified with the applicable TSO marking:

Type I -- Transports (9g forward load)

Type II -- Normal and Utility

Type III -- Acrobatic

Type IV -- Rotorcraft

(ii) New models of seats and berths that are to be so identified and that are manufactured on or after May 1, 1972, must meet the standards set forth in National Aircraft Standard (NAS) Specification 809, dated January 1, 1956 with the exceptions covered in subparagraph (2) of this paragraph. NAS 809 is incorporated by reference herein in accordance with 5 U.S.C. 552(a)(1) and § 37.23 and is available as indicated in § 37.23. Additionally, NAS 809 may be examined at any FAA regional office of the Chief Engineering and Manufacturing Branch (or in the case of the Western Region, the Chief Aircraft Engineering Division), and may be obtained from the National Standards Association 1321 14th Street NW., Washington, DC 20005, at the cost of three (3) dollars.

(2) Exceptions. (i) The sideward loads as specified in 4.1.2. Table I need not exceed the requirement of the applicable Federal Aviation Regulations.

(ii) In lieu of compliance with paragraph 2.1, 3.12, and 4.32 of NAS 809, materials in Type I seats and berths must comply with the fire protection provisions of §25.853(b) of this chapter.

(b) Marking. The weight required in §37.7 need not be included.

(c) Previous approved. Seats and berths approved prior to May 1, 1972 may continue to be manufactured under the provisions of their original approval.

[Admt 37-32 F.R. 3973, Feb. 24, 1972]

NATIONAL AIRCRAFT STANDARDS COMMITTEE

AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC., 610 SHOREHAM BUILDING, WASHINGTON 5, D. C.

SPECIFICATION - AIRCRAFT SEATS AND BERTHS

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1. SCOPE

1.1 Scope - This specification defines the minimum performance and safety standards for seats and berths to be installed in certificated aircraft.

1.2 Types - This specification covers all types of crew and passenger seats and berths for civil aircraft use in the following categories:

| | |
|----------|------------------|
| Type I | Transport |
| Type II | Normal & Utility |
| Type III | Acrobatic |
| Type IV | Rotorcraft |

2. APPLICABLE SPECIFICATIONS

2.1 The latest issue and amendment of the following documents are made a part of this specification:

SAE Aeronautical Material Specification AMS 3852, "Flame Resistant Properties for Aircraft Materials"

3. MATERIAL AND WORKMANSHIP

3.1 Materials shall be of a quality which experience and/or tests have demonstrated to be suitable for use in aircraft seats and berths. Workmanship shall be consistent with high-grade aircraft manufacturing practice.

3.1.1 Protection: All members of the structure shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion or other causes where the type of material used requires such protection.

3.1.2 Fire Protection: The covering and upholstery and all other exposed material used in the seat or berth shall have flame-resistant properties as specified in Aeronautical Material

PREPARED BY THE AIRWORTHINESS REQUIREMENTS COMMITTEE

TITLE

SPECIFICATION - AIRCRAFT SEATS AND BERTHS

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Specification (SAE) AMS 3852. If ash trays are installed in or attached to the seat or berth, they shall be of a self-contained, completely removable type.

4. DETAIL REQUIREMENTS

4.1 Design

4.1.1 General: The seat shall be designed so that in any of its adjustable positions and when installed facing in a specified direction or directions, it will provide protection for the occupant, i.e., pilot, cabin attendant, check pilot or passenger.

4.1.1.1 Accommodation for Parachutes: Types II and III seats shall be designed to accommodate passengers wearing parachutes, except that Type II seats designed specifically for NORMAL CATEGORY AIRCRAFT need not comply with this requirement but shall be identified in the marking required in 4.2 as, "FOR NORMAL CATEGORY AIRCRAFT ONLY."

4.1.1.2 Aft Facing Seats: The seat back height shall be sufficient to provide 36-1/2 inches support for the occupant as measured from the point of maximum seat cushion depression to the top of the seat back. This dimension may be determined with the seat statically subjected to the loads specified in Table I. Padding for the back of the head should prevent "bottoming" on the seat structure unless this structure is designed to absorb the remaining energy.

4.1.2 Strength: All seats and berths intended for single occupancy shall be designed for the ultimate loads specified in Table I. The loads shall be considered as acting separately and shall be based on a passenger weight of 170 pounds for Types I and IV seats and 190 pounds (includes parachute) for Types II and III seats. The weight of the seat or berth times the approximate "g" value shall be added to the ultimate loads specified in Table I. For seats intended for multiple occupancy the loads must be increased accordingly. Ultimate loads are 1.5 times the limit loads.

TABLE I

| Load Direction | Type I | Type II** | Type III | Type IV |
|----------------|-------------------|-------------------|------------------|-----------------|
| Forward | 1530 lbs. (9.0g) | 1710 lbs. (9.0g) | 1710 lbs. (9.0g) | 680 lbs. (4.0g) |
| Sideward*** | 510 lbs. (3.0g) | 570 lbs. (3.0g) | 570 lbs. (3.0g) | 340 lbs. (2.0g) |
| Upward | 340 lbs. (2.0g) | 570 lbs. (3.0g) | 855 lbs. (4.5g) | 255 lbs. (1.5g) |
| Downward | 1020 lbs. (6.0g)* | 1330 lbs. (7.0g)* | 1710 lbs. (9.0g) | 680 lbs. (4.0g) |

* The reason for the down loads exceeding those prescribed in the emergency landing conditions of the applicable Civil Air Regulations is to provide for the reduced weight gust-load-factor or special landing requirements which, in some cases, may be greater than the emergency landing loads.

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4.1.2 (Cont'd.)

** Civil Air Regulations require use of parachute in UTILITY CATEGORY AIRCRAFT operated in acrobatic flight.

*** See 4.3 pertaining to side load for arm rests, Item (c).

4.1.2.1 Pilot and Co-Pilot Seat Loads: In addition to the loads specified in Table I above, pilot and co-pilot seats shall be designed to withstand the following rearward loads applied 8 inches above the intersection of the seat back and seat bottom to provide for the application of pilot forces to the flight controls:

Type I seats 450 pounds

Type II and III seats 300 pounds for aircraft weighing 5000 pounds or under, and 450 pounds for aircraft weighing over 5000 pounds.

Type IV seats 195 pounds

4.1.2.2 Back Rest Loads: The back rest of rearward facing seats, when in the most vertical position, shall withstand the following airplane forward loads applied separately:

Type I Seats - 1530 pounds distributed over the seat back with the load C.G. located 10.5 inches up from the base of the seat back as described in the note in Section 4.3.1.

Types II and III Seats - 1710 pounds distributed over the seat back with the load C.G. located 10.5 inches up from the base of the seat back as described in the note in Section 4.3.1.

4.1.2.3 Casting Factors: If castings are used in the construction of the seat the castings shall have a factor of safety of 2.0 where only visual inspection is employed except that it need not exceed 1.25 with respect to bearing stresses. A safety factor of 1.25 is satisfactory if the casting is substantiated by testing at least three samples and if visual and radiographic inspection is employed on all production castings to assure that they are at least equivalent to the test specimens. The samples shall withstand the ultimate loads multiplied by the 1.25 factor and the limit loads multiplied by the factor of 1.15. These loads should be applied separately. Die castings shall not be used in the primary structure of the seat without 100% radiographic inspection. Casting factors other than those

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4.1.2.3 (Cont'd.)

specified above shall be acceptable if they are found to be appropriately related to tests and to inspection procedures.

4.1.2.4 Ultimate Load Strength: The seat or berth in any of its adjustable positions, when installed facing in a specified direction or directions and when occupied by maximum number of occupants, shall be capable of withstanding ultimate loads without failure for at least three (3) seconds.

4.1.2.5 Limit Load Strength: The seat or berth in any of its adjustable positions shall be capable of withstanding the limit loads without suffering detrimental permanent deformation. At all loads up to these limit loads the deformation shall be such as not to interfere with safe operation of the airplane. (Note: this limit load requirement is not applicable to the forward or the 3 "g" side loading since it is an emergency condition.)

4.1.3 Attachments: For Types I, II and III seats and berths the strength of the seat or berth attachments to the structure and safety belt or shoulder harness attachments to the seat or structure, shall be 1.33 times the ultimate loads specified in Table I except that the down load need not be considered for the safety belt or shoulder harness attachments. When anchorages for safety belts are provided, they should be of a type which will permit self-aligning of the belt or fitting. For berth belt attachments, the factor shall be 1.15.

4.1.4 Projections: The surfaces of the seat shall be free from sharp edges or projections which may chafe the safety belt or shoulder harness webbing. Projections, sharp corners, and other hazardous features, against which the seat occupant may be thrown during a crash, shall be avoided insofar as possible. Any unavoidable features of this nature shall be padded to prevent serious head, neck or chest injury to the occupants.

4.2 Marking: Each seat or berth shall be legibly and permanently marked with the following information:

Manufacturer's Name
Model Number or Name
Seat and Facing Direction (e.g., forward, aft, sideward, swivel)
Serial Number or Date of Manufacture
National Aircraft Standard Number (NAS _____)

4.3 Qualification Tests: Tests shall be conducted as necessary to demonstrate:

- (a) that the seats or berths are capable of supporting the limit loads without detrimental permanent deformation;
- (b) that, at all loads up to limit loads, the deformation shall be such as not to interfere with the safe operation of the aircraft;

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4.3 (Cont'd.)

- (c) that the structure is capable of supporting, without failure for at least 3 seconds, the ultimate loads specified herein when applied separately.

If it can be shown that failure of an arm rest on a seat assembly does not reduce the degree of safety afforded the occupant, such failure will not be cause for rejection.

4.3.1 Detail Qualification Test Requirements: The seat or berth shall be loaded in tests such that the loads imposed on the seat or berth by the occupant(s) in conjunction with the safety belt or belts and their attachments are accurately simulated by means of a block or frame or dummy which is restrained in the seat or berth by the belt or belts attached to their fittings. The tests may be conducted in a jig simulating installation conditions. The ultimate loads, when applied separately, will serve to simulate the loads imposed by the occupant.

| | <u>Forward Facing</u> <u>Seat</u> | <u>Sideward Facing</u> <u>Seat</u> | <u>Rearward Facing</u> <u>Seat</u> |
|--------------|--|--|--|
| Down Load | Evenly over seat bottom | Evenly over seat bottom | Evenly over seat bottom |
| Side* Load | 10.5" up from base of block and about 8.5" forward from back of block. | 10.5" up from base of block and about 8.5" forward from back of block. | 10.5" up from base of block and about 8.5" forward from back of block. |
| Up* Load | " | " | " |
| Forward Load | " | " | Applied as specified in 4.1.2.2 |

*Note: These dimensions for the location of load application assume that the seat and back cushion are in place and that the seat cushion is compressed 2 inches. If the cushions are removed for the test or if the seat cushion compression varies from 2 inches, the location for applying the loads shall be changed accordingly.

This simplified body block is satisfactory for test purposes. It may be refined or modified if desired; however, the application of all test loads should be modified accordingly if necessary.

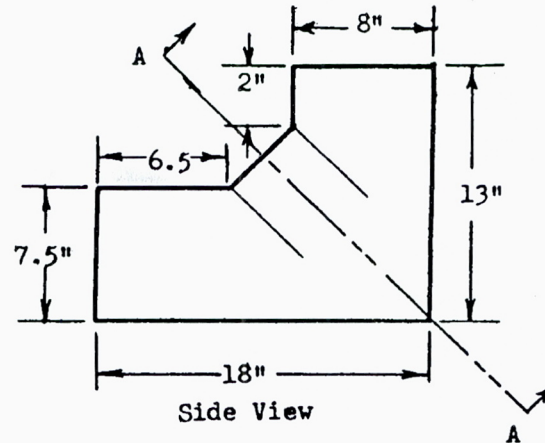
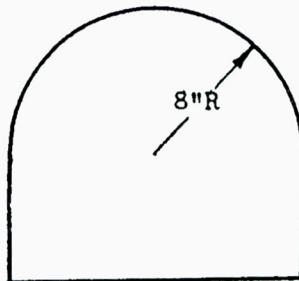
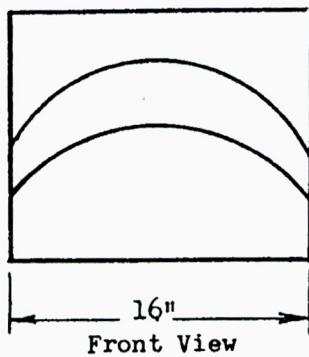
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- 4.3.1.1 When a seat or berth is to be installed or adjusts to face in other than the forward direction, sufficient tests shall be made to substantiate the seat strength for all intended positions.
- 4.3.1.2 When testing for a particular load condition of a vertically or horizontally adjustable seat, the most critical seat position associated with that load shall be used for the test.
- 4.3.1.3 Where the safety belt or belts or harness are not attached to the seat or berth structure, the seat or berth shall be tested for the loads which would be imposed on such installation.

4.3.2 Flame-Resistance Test of Seat Covers: Specimens of the seat covering and upholstery shall meet the applicable tests specified in 3.1.2.

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Federal Aviation Regulation

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▼ Sec. 29.561

| Part 29 AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT | |
|--|------------------------------|
| Subpart C--Strength Requirements | Emergency Landing Conditions |

Sec. 29.561

General.

- (a) The rotorcraft, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this section to protect the occupants under those conditions.
- (b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing when--
 - (1) Proper use is made of seats, belts, and other safety design provisions;
 - (2) the wheels are retracted (where applicable); and
 - (3) The occupant experiences the following ultimate inertia forces relative to the surrounding structure:
 - (i) Upward--1.5g.
 - (ii) Forward--4.0g
 - (iii) Sideward--2.0g
 - (iv) Downward--4.0 g, or any lower force that will not be exceeded when the rotorcraft absorbs the landing loads resulting from impact with an ultimate descent velocity or five f.p.s. at design maximum weight.
- (c) The supporting structure must be designed to restrain, under any load up to those specified in paragraph (b)(3) of this section, any item of mass that could injure an occupant if it came loose in a minor crash landing.
- (d) Any fuselage structure in the area of internal fuel tanks below the passenger floor level must be designed to resist the crash impact loads specified in this section, and to protect the fuel tanks from rupture, if rupture is likely when those loads are applied to that area.

► Comments

▼ **Document History**

Notice of Proposed Rulemaking Actions:

Notice of Proposed Rulemaking. Notice No. 64-30; Issued on 05/20/64.

Final Rule Actions:

Final Rule. Docket No. 5084; Issued on 10/13/64.

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(3) For Paragraph 29.783(h) a means such as a cable, chain, pin, or mechanical linkage should be provided to secure doors used as ditching exits in the open position. The means should be shown to be effective under rotorcraft attitudes and dynamic conditions common to ditching. The sea states for ditching approval in accordance with § 29.801 are found in Paragraph 337 of this AC. Demonstrations under actual ditching conditions are not mandated for substantiation purposes, but the substantiation methodology should be reliable, i.e., an analytical or test method demonstrated to be reliable and used in previous structural substantiation programs.

335. § 29.785 SEATS, SAFETY BELTS, AND HARNESSSES.

a. Explanation.

(1) This section requires that seats, belts, harnesses, and adjacent parts of the rotorcraft be substantiated for the structural loads resulting from the inertia forces of § 29.561 as well as normal flight and ground inertia forces on a 170-pound occupant. The inertia forces of § 29.561 are ultimate loads and must be multiplied by a factor of 1.33 in determining the "strength of attachment" of each seat to structure and each belt or harness to structure. The seat, belt, etc., are required to sustain applied loads and to protect the occupant from serious injury. The pilot seats must also sustain the effects of the pilot forces of § 29.397.

(2) In addition, the "occupant must be protected from head injury" by the seat belt and one of the following:

- (i) A harness to prevent the head from contacting an injurious object.
- (ii) Elimination of injurious object within striking distance of the head.
- (iii) A cushioned rest as specified.

(3) Handholds are required to steady occupants using the aisle in moderately rough air.

(4) Projecting objects which would injure occupants "in normal flight must be padded."

b. Procedures.

(1) Each seat with its belts and harnesses are to be substantiated for the flight, ground, and emergency landing loads of § 29.561 by structural test or stress analysis. Section 29.785(b) states that "each seat must be approved." Certification approval can be gained by Technical Standard Order (TSO) approval or by accomplishing sufficient structural substantiation to gain FAA/AUTHORITY approval of the seat and its belt(s) as

part of the Type Design of the rotorcraft. TSO No. C-39 concerns standards for aircraft seats, including rotorcraft seats. If TSO No. C-39 is used as an approval basis for a specific rotorcraft seat, the seat should be checked to assure it has been substantiated for the vertical (up and down) and side loads imposed by installation in the aircraft. For example, TSO No. C-39 (and NAS 809) specifies an ultimate down load of 4.0g which is in agreement with the 4.0g emergency landing load factor of § 29.561, but it may be less than the design maneuver load factor (which can be as high as 3.5g limit or 5.25g ultimate).

(i) The 1.33 factor is specified for substantiation of attachments of each seat to the structure and each safety belt or harness to the seat or structure for § 29.561 loads, whether analysis or test is used.

(ii) If static testing of seats, belts, and harnesses is used, the body block of NAS 809 may be used. The corners of the NAS 809 body block may be radiused and padded if it is found that the small radii cause premature, unrealistic crippling of thin wall tubing or other structure used in the seat.

(iii) The substantiation of the pilot seats is required to include pilot forces of § 29.397 in conjunction with normal flight and ground loads. For example, the pilot foot force (195 pounds ultimate) must be reacted by the seat.

(2) The following criteria have been found satisfactory for preventing occupant head injuries:

(i) If a harness is used, it should support the shoulders without applying hazardous loads to the side or front of the neck. It should be easily donned and a single point release with the seat belt is preferred. If separate release is provided, it must be simple, compatible with the seat belt release, and near the seat belt release. The harness should be tested in conjunction with the seat belt using a "body block" similar to that of NAS 809 if possible. If the harness is tested separately from the belt, it should be tested to 50 percent of the forward crash loads for the entire occupant weight of 170 pounds, unless that percentage distribution is found to be unrealistic by a rational analysis.

(ii) Elimination of injurious objects within striking distance of the head and other vital parts can be accomplished by removal of objects with sharp edges or rigid surfaces from within striking distance of vital parts of the occupant. Dimensions and weights for typical occupants are available in U.S. Army USAAULABS Reports 70-22 (August 1969) and 66-39 (June 1966) and NACA Report TN 2991 (August 1953). Because of the range of occupant head striking distance, a combination of "elimination of injurious objects" and "cushioned rests" may be required for some interior configurations.

(iii) An acceptable cushioned rest can be provided by use of a 1-inch thickness of foamed polyvinyl chloride (PVC), or equivalent energy absorbing material. The density of material should be in the 5 to 10 pounds per cubic foot density range. PVC foam has the property of absorbing energy efficiently with negligible rebound effects. PVC foam recovers slowly to the original configuration after deformation. If PVC foam is used, however, care must be taken in its application relative to its flammability characteristics (reference § 29.853).

(3) Handholds for the occupants are generally provided by seat backs adjacent to the aisle. If the seat backs fold, the amount of support provided by the seat backs before they fold must be evaluated in a furnished interior or mock up. To provide adequate support, the seat back may use an easily disengaged latch or adequate friction in the hinge mechanism to obtain adequate support. Handholds along the aisle are, of course, not needed for rotorcraft with no aisles or where seat belts must be fastened during flight.

(4) Projecting objects which could injure occupants in normal flight should be padded. The amount of padding required depends on the location, size, and minimum radius of the projecting object. In general, this requirement will mean that sharp edges must be padded with one-half inch of PVC foam or equivalent (5 to 10 lbs. density), while objects with radii in excess of 1 inch may meet the requirements of § 29.785(e) with a lesser amount of energy absorbing padding, if it can be contacted only by persons "moving about in the rotorcraft in normal flight."

335A. § 29.785 (Amendment 29-29) SEATS, BERTHS, BELTS, SAFETY BELTS, AND HARNESES.

a. Explanation. Amendment 29-29 makes the following changes to § 29.785:

(1) The title of § 29.785 now includes berths (which would include litters).

(2) Section 29.785(a) has been revised to include reference to the new § 29.562, "Emergency Landing Dynamic Conditions."

(3) Section 29.785(b) has been revised to include a reference to the new § 29.562(c)(5) head injury criteria and to describe a torso restraint system that is contained in TSO-C114.

(4) Section 29.785(f) has been revised to change the percentage of load distribution for safety belt and harness combination to 60-40.

(5) A new § 29.785(i) has been added which provides a list of "seating device system" components.

(6) A new § 29.785(j) provides for deformations of the seat energy absorption device system installed to meet the requirements of § 29.562 but requires that the system “remain intact and not interfere with rapid evacuation of the rotorcraft.” Further “structural” performance standards are contained in §§ 29.562(c)(1) and (2). AC 20-137 also contains information.

(7) A new § 29.785(k) provides static strength and restraint requirements for litters and berths. Litters may be oriented laterally as well as longitudinally in the rotorcraft. Dynamic tests of litters are not required. For longitudinally oriented litters, features should be provided to protect the occupant from the increased loads in § 29.561(b) of Amendment 29-29.

b. Procedures. The procedures of Paragraph 335 still apply to static substantiation of the seats, berths, safety belts, and harness. In addition:

(1) Compliance with § 29.562 (except litters are not included) and § 29.561(b) is required.

(2) Section 29.562 includes a specific pass fail criteria, which includes head injury criteria, (reference AC 20-137).

(3) Shoulder harnesses need only be substantiated for 40 percent of total occupant load rather than the former 60 percent adopted by Amendment 29-24.

(4) AC 20-137 provides guidance for evaluating the functioning of a seating energy absorption device system under dynamic test conditions. Stroking is associated with the vertical-horizontal impact case and is recognized in the static strength substantiation.

(5) Berths or litters installed within 15° or less of the rotorcraft longitudinal axis (oriented longitudinally) shall use a combination of restraint devices, such as are required to be equipped with a padded end-board, cloth diaphragm, or equivalent means to withstand and distribute the occupant loads resulting from § 29.561(b) requirements. Other berths or litters may be equipped with straps or safety belts to withstand the forward reaction of § 29.561(b) as well as other loads, including flight loads.

(i) Berths/litters may be substantiated by static load tests, analysis, or a combination thereof and need not be substantiated to the 1.33 fitting factor of seat installations.

(ii) The berth/litter occupant's head, neck, and spine should be protected from (landing) impact forward loads by appropriate design means; e.g.,

- non-longitudinal orientation of the berth/litter; or

- "feet forward" orientation; or
- distribution of an appropriate percentage of forward loads on the shoulders (not solely to the head and spine).

(iii) Recommendations for litter occupants:

- If the occupant's head is oriented forward, a shoulder harness should be provided, in conjunction with body and leg straps that prevents the occupant's head from falling off the litter. A padded end board, diaphragm, etc., may be used, provided head and spinal loads are alleviated or prevented.
- If the occupant's feet are oriented forward, the padded end board may also be used in combination with the body and leg straps or other such restraints.
- Multiple or combinations of devices should be used to distribute the occupant loads as well as protect the occupant from possible neck and spine compression.

336. § 29.787 (Amendment 29-12) CARGO AND BAGGAGE COMPARTMENTS.

a. Explanation.

(1) This section requires that cargo and baggage compartments be designed for normal flight and ground loads and for a 4g ultimate forward load condition. Maximum placarded weights and critical distributions are to be considered.

(2) Means to prevent cargo shifting and contact between any cargo lamp bulb and cargo is to be provided.

b. Procedures. Structure tests or analyses may be used for substantiation for the design loads.

(1) Nets or straps may be used to prevent cargo shifting. The nets or straps are required to be substantiated for the structural loads. They need a means for adjustment to assure proper restraint for different sizes and shapes of cargo.

(2) Cargo lamp bulbs need to be guarded, recessed, or placed in upper inside corners to prevent contact with cargo.

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▼ Sec. 29.785

| Part 29 AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT | |
|--|------------------------------------|
| Subpart D--Design and Construction | Personnel and Cargo Accommodations |

Sec. 29.785

Seats, safety belts, and harnesses.

(a) The seats, safety belts, shoulder harnesses, and adjacent parts of the rotorcraft, at each station designated for occupancy during takeoff and landing, must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in Sec. 29.561.

(b) Each seat must be approved.

(c) Each occupant must be protected from head injury by--

(1) A safety belt and harness that will prevent the head from contacting any injurious object;

(2) A safety belt plus the elimination of any injurious objects within striking radius of the head; or

(3) A safety belt plus a cushioned rest that will support the arms, shoulders, head, and spine.

(d) If seat backs do not have a firm handhold, there must be hand grips or rails along each aisle to let the occupants steady themselves while using the aisle in moderately rough air; and

(e) Each projecting object that would injure persons seated or moving about in the rotorcraft in normal flight must be padded.

→ (f) Each seat and its supporting structure must be designed for an occupant weight of 170 pounds, considering the maximum load factors, inertia forces, and reactions between the occupant, seat, and safety belt or harness corresponding with the applicable flight and ground load conditions, including the emergency landing conditions of Sec. 29.561. In addition--

(1) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in Sec. 29.397; and

(2) The inertia forces prescribed in Sec. 29.561 must be multiplied by a factor of 1.33 in determining the strength of the attachment of--

(i) Each seat to the structure; and

- (ii) Each safety belt or harness to the seat or structure.

► **Comments**

▼ **Document History**

Notice of Proposed Rulemaking Actions:

Notice of Proposed Rulemaking. Notice No. 64-30; Issued on 05/20/64.

Final Rule Actions:

Final Rule. Docket No. 5084; Issued on 10/13/64.

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